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Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554

JUN 29 1993

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

In the Matter of  
  
Amendment of Part 90  
of the Commission's Rules  
to Adopt Regulations  
for Automatic Vehicle  
Monitoring Systems

PR DOCKET NO. 93-61  
RM-8013

To: The Commission

COMMENTS OF  
  
NORTH AMERICAN TELETRAC  
AND LOCATION TECHNOLOGIES, INC.

VOLUME I

PRESTON GATES ELLIS  
& ROUVELAS NEEDS  
STANLEY M. GORINSON  
JOHN LONGSTRETH  
Suite 500  
1735 New York Avenue, N.W.  
Washington, D.C. 20006-4759  
(202) 628-1700

Counsel for North American  
Teletrac and Location  
Technologies, Inc.

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SUMMARY

The NRRM contains a number of proposals which will improve

In addressing the wideband sharing issue, which we believe to be the key issue remaining for decision, the Commission will be asked to weigh technical and economic realities against speculative claims of future competitive benefits. Those claims have, ironically, been advanced largely by parties who have not yet operated workable LMS technology. Indeed, when the Commission last considered this technology, in 1974, it was deluged with suggestions from parties who claimed to be developing AVM technology, but afterwards never placed a system in operation.

To help the Commission separate fact from hope and speculation, Teletrac has presented several reports from experts with unimpeachable credentials. Professor Raymond Pickholtz, of George Washington University, has analyzed the technical aspects of sharing. He concludes that performance of a wideband pulse ranging LMS system, including a system such as the one Pinpoint

system is operating close to the bounds of engineering feasibility, so there is no quick fix to the problem.

Economic analysis confirms the lack of feasibility of LMS sharing. Paul Jansen, of McKinsey & Company, Inc., concludes that a high capacity, low-cost system is necessary to survive in the LMS marketplace. Professor Richard Schmalensee, Billiard Professor of Economics at MIT, and Dr. William Taylor, Senior Vice President of National Economic Research Associates, show that sharing would impose enormous costs on LMS providers, making it highly unlikely that a viable business could exist. Moreover, they demonstrate that the purported competitive benefits of such sharing are largely illusory, particularly in light of the technical requirements that would have to be met.

Homilies about competition, or meaningless statements about the supposed "fragility" of wideband systems, cannot camouflage the reality that co-channel operation of LMS systems will not work. In a number of recent private radio proceedings, the Commission has recognized that licensees must be protected from harmful co-channel interference in order to provide reliable and efficient service. Sound analysis concludes that co-channel separation is necessary and proper for LMS services as well.

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North American Teletrac and Location Technologies, Inc., doing business through their joint venture PacTel Teletrac ("Teletrac"), applaud the Commission's decision to modernize the "interim" automatic vehicle monitoring ("AVM") rules adopted almost twenty years ago.<sup>1</sup> As the Commission's Notice of Proposed Rulemaking ("NPRM") notes, "AVM technology and experience have developed to a point where permanent provisions will further the public interest." NPRM ¶ 1.

Teletrac believes there is much in the NPRM to advance the Commission's efforts to create rules that will "provide a competitive and dependable environment in which AVM systems can continue to develop." NPRM ¶ 5. For example, separating narrow and wideband pulse-ranging systems will enhance the ability of both to provide reliable service. Expanding the uses for this

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<sup>1</sup> Report and Order Inquiry As To Automotive Vehicle



technology and broadening the category of eligible users will permit a variety of new services for an ever-expanding group of consumers. As Teletrac has repeatedly suggested to the Commission, it is the mass market that will determine the future success of the newly-named Location and Monitoring Service ("LMS"). It is with that incontrovertible fact in mind that our Comments discuss other proposals to the NPRM, which, if adopted, could result in the destruction of significant portions of the LMS industry.

Specifically, sharing between wideband pulse-ranging systems would be both technically and economically infeasible. To demonstrate the strength of that assertion, we are today submitting

-- a report on the technical infirmities of sharing prepared by Dr. Raymond Pickholtz, Professor of Engineering at George Washington University (the "Pickholtz Study") (Appendix 1), and a field test and simulation of interference between wideband systems, like the system proposed by Pinpoint,<sup>2</sup> conducted by Teletrac and reviewed by Professor Pickholtz (the "Teletrac Study") (Appendix 2);

-- a study on the economics of sharing prepared by Dr. Richard Schmalensee, Gordon Y. Billiard Professor of Economics at the Massachusetts Institute of Technology and Dr. William Taylor,

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<sup>2</sup> Pinpoint Communications, Inc. ("Pinpoint") has advocated sharing among wideband systems without suggesting any

Senior Vice President, National Economic Research Associates ("NERA") (the "Schmalensee-Taylor Study") (Appendix 3); and

-- a declaration discussing the LMS business prepared by Paul Jansen, a Principal at McKinsey & Company, Inc. (the "Jansen Decl.") (Appendix 4).

These independent experts, with impeccable credentials, unequivocally support the conclusion that without co-channel separation there will be no wideband pulse-ranging LMS business. Teletrac, the only company with wideband pulse-ranging systems in commercial operation, will be unable to provide this service. Many of the other commenters, unencumbered by the experience that comes from having built and operated LMS systems, claim wonders

## I. BACKGROUND

There has been much already submitted in this record about the meaning of the Commission's interim rules and the events leading to the NPRM. Teletrac is confident in its view -- which is strongly supported by the record leading to adoption of the interim rules and the language of those rules<sup>3</sup> -- that the currently indiscriminate licensing of narrowband systems such as Amtech (see NPRM ¶ 26) in the wideband pulse-ranging allocation is inconsistent with the interim rules. More importantly, that indiscriminate licensing has imposed a de facto freeze on the ability of wideband pulse-ranging providers, such as Teletrac, to construct systems.<sup>4</sup> Thus, given the certainty of interference and lack of certainty associated with the Commission's proposed licensing rules, there is little incentive to make the

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<sup>3</sup> Appendix 5 to these Comments contains a history of the proceedings leading to adoption of the 1974 interim rules. Contrary to the NPRM's summary conclusion in footnote 29 that there is "not . . . sufficient evidence" to support Teletrac's analysis, the record, the language of the rules themselves, and accepted rules of construction all provide overwhelming evidence that the only realistic construction of those rules is the one put forward by Teletrac.

<sup>4</sup> Given that fact, Teletrac has applied for an across the board freeze on new license grants and special temporary authorities until this rulemaking is concluded. Teletrac's application for freeze filed May 21, 1993 (the "Freeze Application") has been opposed by five parties on various grounds. All appear to be based on the reality that the current situation enables these opponents to continue obtaining licenses to build systems which cause harmful interference, thereby further chilling Teletrac's incentives to build systems. As a general matter none of the opponents seem to rely on the language of the rules or the proceedings leading to those rules to support their position.

substantial investments necessary to make wideband pulse-ranging systems a reality across the country.

**A. The 1974 Rulemaking Proceedings**

Although numerous companies claimed during the proceedings leading to adoption of the 1974 interim rules that they would deploy systems, not one of these ever did. Moreover, all of those companies knew -- a reality strangely absent from most of the Comments filed to date in this proceeding -- that only one or two pulse-ranging systems at most could be deployed in a geographic area. For example, Hazeltine Corp. stated that there should only be one or two systems in a metropolitan area.<sup>5</sup> The Institute of Public Administration, then conducting an AVM study for the federal government, argued for only one system since that would reduce cost to users, exploit economies of scale and prevent inefficient high cost, special purpose systems from preempting the spectrum.<sup>6</sup> Hazeltine then submitted a petition for rulemaking which led directly to adoption of the interim rules, explicitly stating that only two systems could be accommodated in each geographic area.<sup>7</sup>

The system which Hazeltine proposes to provide for AVM information service is based on pulse transmissions. Consequently, the

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<sup>5</sup> See Appendix 5 at 3, 6.

<sup>6</sup> Id. at 2-3.

<sup>7</sup> Petition of Hazeltine Corp. for the Establishment of a New Radio Service, RM-1734, filed Dec. 24, 1970 (hereinafter "Hazeltine Petition").

bandwidth required by the system is 10 MHz. However, one 10 MHz channel will be sufficient to serve the vehicle monitoring information needs of tens of thousands of vehicles in a large population center. Furthermore, there is sufficient bandwidth in the proposed allocation to permit two pulse systems in the same area, each using 10 MHz of bandwidth, with 6 MHz of separation (the ISM mid-band) between them. It is unlikely that the market would support more than two high-capacity services in the same area. Similarly, since transmissions at the frequencies under discussion are line-of-sight, there is small likelihood of interference between systems operating in separate large population centers. But in the event of two independent systems operating in centers close enough so that interference by line-of-sight transmission is possible, two different 10 MHz systems could operate without mutual interference.

-- Hazeltine Petition at 29-30.  
(Emphasis supplied).

There is no discussion in the 1974 Report and Order, or in any of the proceedings and comments leading up to it, of any intention to allow multiple wideband systems to share frequencies, of any justification for doing so, or of any method by which the resulting interference would be controlled or regulated.

As noted previously a large number of commenters represented, between 1968 and 1974, that they were developing AVM systems.<sup>8</sup> Almost 20 years later, only Teletrac has a wideband pulse-ranging system in commercial operation. Given this history, the Commission should view with great skepticism claims

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<sup>8</sup> See Appendix 5 at 9, n.23.

of commenters who have no experience designing, constructing or

sixteen million radio location units ("RLU")<sup>10</sup> and handle up to six million location requests per day in a specific geographic area -- or roughly 4,000 location requests per minute. This large capacity will reduce user costs, making the technology available to a vast array of consumers, each with different needs throughout a metropolitan area.<sup>11</sup> According to Paul Jansen of McKinsey & Company.

We concluded that Teletrac has the potential to provide an array of location and related services, but that to succeed in the highly competitive markets for such services it needs to be able to offer a high capacity system, at low cost to consumers, which can be used for personal as well as vehicle location services. Unless Teletrac is able

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<sup>10</sup> The RLU transmits a wideband signal received at various radio sites. For a fuller explanation of how the Teletrac system operates. See Teletrac Petition ¶¶ 6-9.

<sup>11</sup> Thus, wideband pulse-ranging services differ markedly from technologies called variously automatic vehicle or equipment

to develop and market a small low-cost receiver and to develop and deploy a high capacity system, it is unlikely that Teletrac will prove viable in the highly competitive markets of the late 1990s.

-- Jansen Decl. at ¶ 3.

The Teletrac Petition urged adoption of permanent rules, since evolution of AVM technology has uncovered various impediments in the interim rules including

- a definition limiting the service to vehicles even though the technology has advanced beyond vehicle location
- increasing potential for interference as systems proliferate
- the lack of modern technical specifications and equipment authorization procedures
- the lack of a standardized frequency for a forward link, threatening increased potentials for interference
- an adverse impact on capital investment simply because the rules were interim.

Petition ¶ 23.

## II. DISCUSSION

### A. The Commission's Proposal To Expand The Types Of Entities Eligible To Use LMS Service Is In The Public Interest

The NPRM proposes to permit LMS services to locate all types of objects, both animate and inanimate. NPRM ¶ 9.<sup>12</sup> Teletrac supports this proposal to broaden permissible uses of LMS because it will enable the public to achieve the full benefits of this

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<sup>12</sup> The Commission further proposes that Part 90 be amended to permit an LMS licensee to provide service to individuals and the Federal Government. Teletrac supports this proposal.



service. LMS technology is presently capable of multiple uses, and artificial regulatory restrictions should not be used to limit its benefit.

Teletrac agrees with the NPRM's decision to retain the last sentence of the LMS definition proposed by Teletrac, which states "LMS systems may also transmit and receive status and instructional messages to the units involved." Id. While this capability is valuable to the public, it should be ancillary to location services.

Teletrac also believes it essential for the Commission to

~~define what a pulse measuring technology is for the purpose of~~

locators will not markedly increase noise because of the lower power and the low height of the antenna in portable units to be used for that service.<sup>13</sup> Moreover, if wideband pulse-ranging and

<sup>13</sup> Teletrac has designed its system with Part 15 equipment in mind, and we believe that our systems will continue to operate reliably. Part 15 noise levels are far lower than the

narrowband systems are in different bands, and co-channel separation is implemented for wideband pulse-ranging systems, these systems will be able to operate to their full capacity and rapid congestion should not occur.<sup>14</sup>

**B. The Commission's Proposed Spectrum Assignment And Licensing Proposals Require Revision**

The Commission has proposed to place non-pulse-ranging systems in the 902-904, 912-918 and 926-928 MHz bands. These systems would have a maximum authorized bandwidth of 6 MHz. See proposed rule § 90.209(b)(10); NPRM ¶ 15. Wideband pulse-ranging systems would be licensed in the 904-912 and 918-926 MHz bands with a minimum authorized bandwidth of 2 MHz. See id.

The Commission acknowledges that, until now, licenses in the 904-912 and 918-912 MHz bands

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has proposed to make the band 1910-1930 MHz available for unlicensed PCS -- a service that will accommodate systems (such as wireless LANs and PBXs) now operating in the 902-928 MHz band.

Consequently, while we recognize that there will be occasional instances where Teletrac can and should work with Part 15 users and manufacturers to eliminate interference problems, we do not anticipate any need to modify the Commission's Part 15 policies. Part 15 equipment should not be eliminated from 902-928 MHz.

<sup>14</sup> Conversely, as discussed more fully in the technical studies we have submitted, sharing regimes are likely to substantially reduce system capacity and performance, assuming they are workable at all, and would pose significant congestion concerns.

have been granted without regard to the compatibility of co-channel systems, the method of operation of the AVM systems, or the operating bandwidth of the individual systems.

-- NPRM ¶ 10.

The Commission further acknowledges that co-channel noise makes it difficult in these circumstances, if not impossible, for wideband pulse-ranging systems to operate. NPRM ¶ 14. The Commission therefore proposes to enforce a separation of wideband pulse-ranging services from other services. Id. ¶ 16.

To this point, the Commission's analysis is fully consistent with Teletrac's own experience, and with the interference studies Teletrac presented with its Petition for Rulemaking. At this point, however, the NPRM suffers a disconnect. Moving to licensing of wideband systems, it disregards the abundant evidence of co-channel interference problems and expresses the belief -- without any basis for that belief -- that it may be possible for pulse-ranging systems to share spectrum in the same area. The Commission, accordingly, seeks comments on whether it is feasible for wideband systems to share spectrum. Id.

¶¶ 21-22.

The licensing scheme for LMS is the most significant issue in this proceeding. Adoption of a mandatory sharing regime for wideband pulse-ranging systems -- in the face of the overwhelming technical and economic arguments that militate against sharing -- may lead to another twenty-year period in which LMS services do not develop. Final rules which do not include co-channel

separation between wideband pulse-ranging systems would necessarily mean that the Commission has totally ignored the realities of these systems.

1. Some Preliminary Observations

a. The concept of "fragility" advanced by some commenters has no content

Various commenters who oppose separating narrowband and non-pulse-ranging systems from wideband pulse-ranging systems, or who oppose co-channel separation between wideband pulse-ranging systems, have repeatedly accused Teletrac of having a "fragile" system -- i.e., one not capable of working with other systems in a shared band. Of course, the reality is different.

Teletrac's wideband pulse-ranging system has been engineered to exist in the 902-928 MHz band with ISM and government systems being primary. This proceeding will not change the existing hierarchy of use. Teletrac has not asked for such a change. That is not "fragility."<sup>15</sup>

By any ordinary measure, Teletrac's system is extremely well-engineered and well-suited to operate in the 902-928 MHz band. The Pickholtz study demonstrates the Teletrac system operates near the statistical limits of any system's ability to estimate location. This limit, known as the Cramer-Rao bound, demonstrates the best that a system can do based on its engineering design. Persuasive evidence shows that the Teletrac

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<sup>15</sup> "Fragility" has been defined as "brittle; easily broken; weak; liable to fail; easily destroyed; frail; delicate. Webster's New Universal Dictionary 727 (1976).

system is well-engineered and state of the art. It operates extremely well in the environment for which it was designed. As Professor Pickholtz has concluded

. . . better engineering of the Teletrac receiver system cannot protect against such interference. The laws of physics and statistics prevent this technical fix.

-- Pickholtz Study at 23.

The sharing proponents' claims of "fragility" and "robustness" are will-o-the-wisp concepts. Some commenters like to use the term "fragile" when describing Teletrac's system because they prefer labels to a discussion of the laws of physics. Indeed, their concept of "fragility" applies just as firmly to these commenters' own systems. For example, in ET Docket No. 93-59, Amtech has raised the question of whether Radian Corporation's wind profiler radars would interfere with Amtech's tag readers

[I]t appears from the petition that Radian would also like to sell its product for use in areas more densely populated with radio users, such as in the vicinity of airports. Such operation could pose a threat to an increasing number of AMTECH AVM systems located at airports, including systems in Los Angeles and New York . . . Even in more rural areas, wind profiler operation could interfere with other uses of the band.

-- Comments of Amtech Corporation at 9.  
(Emphasis supplied).

Amtech would obviously consider it no answer if Radian simply responded by calling Amtech's system "fragile."

Pinpoint, which has also proclaimed Teletrac's "fragility" and its own "robustness," seems to have an even worse problem. Its system does not work<sup>16</sup> -- the ultimate in "fragile" systems.

In short, the term "fragile" lacks content. All systems are "fragile" given sufficient interference. The real question is how to achieve maximum efficient use of LMS technology, taking into account engineering reality and concepts of spectral and economic efficiency. As we discuss in great detail below, supported by independent engineering and economic reports from extremely respected analysts, efficiency goals dictate separation of wideband pulse-ranging and narrowband systems, as well as co-channel separation of wideband systems.

**b. The concept of competition**

Competition is also a term that has been used in a skewed manner in this proceeding. For example, the Commission in February 1993 reiterated its view that radio location is competitive.<sup>17</sup> In this NPRM, however, the Commission states its belief that non-exclusive licensing of LMS systems is necessary to promote competition within the LMS industry. NPRM ¶ 21.

Teletrac respectfully suggests that the view of competition stated in the NPRM is not in accord with the reality of this industry. Professor Schmalensee, in an Affidavit dated August 5,

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<sup>16</sup> Land Mobile News, April 23, 1993, at 5.

<sup>17</sup> Notice of Proposed Rulemaking, In the Matter of Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Non-Voice, Non-Geostationary Mobile-Satellite Service, CC Docket 92-76 (released Feb. 10, 1993), ¶ 35.

1992, filed in support of Teletrac's Petition for Rulemaking,  
stated

Pinpoint and Amtech appear to argue that Teletrac's proposal to continue licensing only wideband pulse-ranging systems in the 904-912 MHz and 918-926 MHz bands would create a "duopoly" consisting of Teletrac and one other wideband licensee, since each would have control over one of the two 8 MHz wideband channels. But an economically meaningful duopoly exists if and only if a supplier of a good or service faces only one competitor. As Pinpoint's own opposition acknowledges, there are other competitors in the AVM market: Lo-Jack, Trimble and numerous other firms provide various types of AVM services, in a variety of frequency bands. Moreover, nothing in the proposed rulemaking prevents Pinpoint, AMTECH or any other firm from developing and marketing new technologies for wideband or narrowband systems or developing entirely new AVM services. Contrary to Pinpoint's and AMTECH's assertions, therefore, Teletrac's proposal would foster a competitive AVM marketplace.

-- Schmalensee Affidavit  
at ¶ 5.<sup>18</sup>

Sharing, as discussed in great detail below, makes little technical sense. See Pickholtz Study, Appendix 1 to these Comments. Nor does it make any economic sense. Drs. Schmalensee and Taylor have submitted a study on the economic issues associated with sharing (Appendix 3). They conclude, among other things, that:

-- Sharing will not necessarily lead to a large number of competitors, because without co-channel

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<sup>18</sup> Affidavit of Professor Richard Schmalensee, Exhibit B to Reply Comments of North American Teletrac and Location Technologies, Inc. in Support of Petition for Rulemaking ("Petition Reply Comments"), RM No. 8013 (filed August 7, 1993).



separation to reduce interference potential, the uncertainty of entry is greatly increased. Schmalensee-Taylor Study at 5.

- Wideband pulse ranging systems exhibit high fixed costs making it unlikely that the market can support a large number of competitors. Id. at 6, 27-30.
- Expanding the number of competitors would not significantly reduce price since "the LMS market demand curve is relatively elastic." Id. at 13.
- Expanding the number of competitors will not increase spectrum efficiency since "as more firms share a fixed amount of frequency, the total number of customers that can be shared by all firms together falls." Id. at 14.

In short, what may appear at first blush to be "competitive"